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ATCRBS / Mode S Transponder MOPS Maintenance
Meeting #7

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Representation of Numerical Data
DO-260A versus Doc 9871

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SUMMARY

This Working Paper presents differences in the language presented in the previous ICAO Doc 9688 and in the published DO-260A versus what has been modified in the current draft, and soon to be published ICAO Doc 9871 as the Detailed Technical Requirements for 1090 MHz Extended Squitter, AND asks the question “Which is correct?”

1.0 Introduction

During the recently held ICAO ASP TSG meeting in Paris, there was a discussion which focused on section §A.2.2.2 entitled “Representation of Numerical Data.” Since there was also a section in Appendix A of RTCA/DO-260A of the same title, the MOPS document was opened to compare the text. It was discovered that for one specific section, the language had been completely reversed in the current draft of the soon to be published ICAO Doc 9871. It was decided that this Working Paper should be brought to a discussion at RTCA SC-209 / Eurocae WG-49 to see if the difference could be explained.

2.0 Representation of Numerical Data in RTCA/DO-260A

Numerical data **shall** be represented as follows:

1. Numerical data are represented as binary numerals. When the value is signed, 2’s complement representation is used, and the bit following the status bit is the sign bit.
2. Whenever applicable, the resolution has been either tailored to the corresponding ARINC 429 label or aligned with ICAO documents.
3. Unless otherwise specified, whenever more bits of resolution are available from the data source than in the data field into which that data is to be loaded, the data **shall** be rounded to the nearest value that can be encoded in that data field.
4. Where ARINC 429 data are used, the ARINC 429 status bits 30 and 31 are replaced with a single status bit, for which the value is VALID or INVALID as follows:
 - a) If bits 30 and 31 represent “Failure Warning, No Computed Data” then the status bit **shall** be set to “INVALID.”
 - b) If bits 30 and 31 represent “Normal Operation,” “plus sign,” or “minus sign,” or “Functional Test” then the status bit **shall** be set to “VALID” provided that the data are being updated at the required rate.
 - c) If the data are not being updated at the required rate, then the status bit **shall** be set to “INVALID.”

For interface formats other than ARINC 429, a similar approach is used.

3.0 Representation of Numerical Data in ICAO Doc 9871

Numerical data shall be represented as follows:

- 1) Numerical data shall be represented as binary numerals. When the value is signed, 2s complement representation shall be used, and the bit following the status bit shall be the sign bit.
- 2) Unless otherwise specified, whenever more bits of resolution are available from the data source than in the data field into which that data are to be loaded, the data shall be rounded to the nearest value that can be encoded in that data field.

Note.— Unless otherwise specified, it is accepted that the data source may have less bits of resolution than the data field.

- 3) When the data source provides data with a higher or lower range than the data field, the data shall be truncated to the respective maximum or minimum value that can be encoded in the data field.
- 4) Where ARINC 429 data are used, the ARINC 429 status bits 30 and 31 shall be replaced with a single status bit, for which the value is VALID or INVALID as follows:
 - a) If bits 30 and 31 represent “Failure Warning, No Computed Data” then the status bit shall be set to “INVALID”.
 - b) If bits 30 and 31 represent “Functional Test” then the status bit shall be set to “INVALID”.
 - c) If bits 30 and 31 represent “Normal Operation,” “plus sign,” or “minus sign,” then the status bit shall be set to “VALID” provided that the data are being updated at the required rate (see §A.2.1.1).
 - d) If the data are not being updated at the required rate (see §A.2.1.1), then the status bit shall be set to “INVALID”.